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(71) Applicant: Samsung Electronics Co., Ltd.
Suwon-city, Kyungki-do (KR)

(72) Inventor: Ko, Jung-Wan
Suwon-shi, Kyonggi-do (KR)

(74) Representative: Chugg, David John et al
Appleyard Lees,
15 Clare Road
Halifax, West Yorkshire HX1 2HY (GB)

(54) Optical disk satisfying plural standards

(57) An optical disk includes a first recording layer (14) for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a first standard, and a second recording layer (16) for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a second standard different from the first standard.

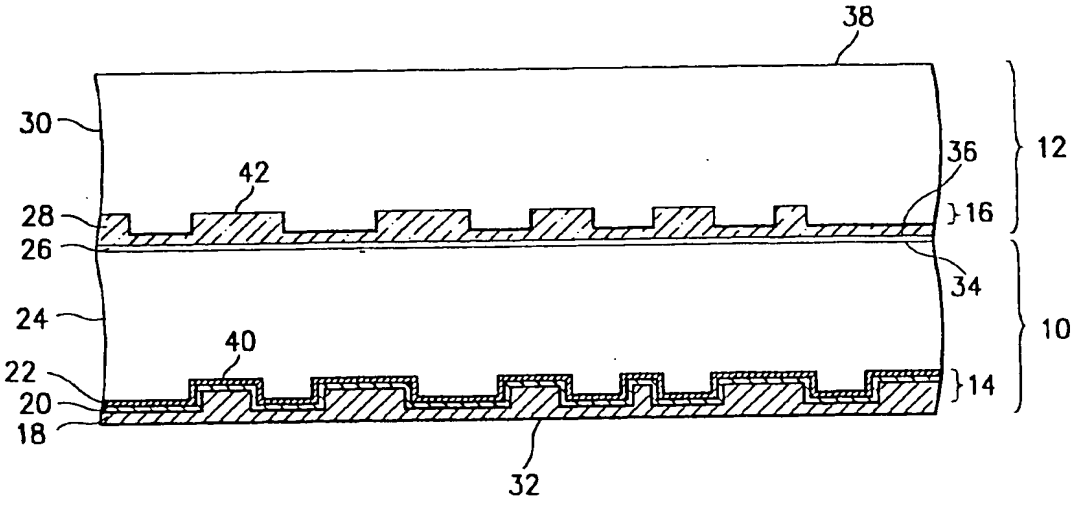

FIG. 1

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Description

The present invention relates to an optical information recording medium, and in particular, to a multilayered optical disk.

An optical disk, one of optical information recording media, is widely used to record and reproduce various data including audio and video data. Such optical disks include a compact disk (CD), a digital video disk (DVD), a laser disk (LD), and a mini disk (MD). Among them, the CD is a major optical disk which has widely been used so far, and the DVD had recently emerged. The DVD is expected to find wide use as a next generation recording medium for recording and reproducing video and audio data because it can accommodate 17-GB data in maximum, enough to store one movie on a single disk, using high-density digital compression technology, it is as large as a conventional CD, provides higher image quality than an LD, and allows simultaneous dubbing of a plurality of languages for a movie to be appreciated in a selected language.

Meanwhile, CDs and their reproducing devices are widely used in audio systems, whereas DVDs and their reproducing devices have just started to be provided. Hence, CDs will be more popular than DVDs at least for the time being. In this context, it is preferable to fabricate a DVD which can be compatibly reproduced in both CD and DVD reproducing devices.

However, CD and DVD systems differ in standard, wavelength of light used for reproducing data, and mechanical mechanism. That is, light sources as provided in CD and DVD standards are a 780nm infrared laser and a 680-635nm red laser, respectively. Besides, a CD is 1.2mm thick, while a dual DVD currently used is a stack of two 0.6mm-thick disks with their respective recording layers attached to each other to allow recording and reproduction of data on and from both surfaces.

As described above, a single optical disk cannot accommodate both types of data separately reproducible in a conventional CD reproducing device and a DVD reproducing device.

Therefore, due to its inability of satisfying different standards of reproducing devices the optical disk cannot be used concurrently and compatibly for different purposes. The same problem is encountered when different light sources or mechanical mechanisms are used for different standards.

Accordingly, an aim of preferred embodiments of the present invention is to provide an optical disk satisfying different standards.

According to a first aspect of the invention, there is provided an optical disk comprising: a first recording layer for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a first standard; and a second recording layer for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a second standard different from the first standard.

Preferably, the distance between a reproduction surface of the optical disk and the second recording layer is based on the second standard, and the distance between the reproduction surface and the first recording layer is based on the first standard.

Preferably, the light of the first standard is a 780nm laser beam, and the light of second standard is a 680-635nm laser beam.

Preferably, the first standard is a CD (Compact disk) standard, and the second standard is a DVD (Digital Video disk) standard.

The light of the first standard is preferably between 680nm and 635nm, and the light of the second standard is shorter than 600nm.

According to a second aspect of the invention, there is provided an optical disk comprising; a first disk having a first transparent substrate and a first recording layer formed on a surface of the first transparent substrate, for reflecting light of a wavelength based on a first standard and absorbing light of a wavelength based on a second standard different from the first standard in order to record first standard data therein; and a second disk having a second transparent substrate and a second recording layer formed on a surface of the second transparent substrate, for transmitting the first standard light and reflecting the second standard light at a reflectance set by the second standard in order to record second standard data therein, wherein a first surface of the first disk remote from said first recording layer is connected to a second surface of the second disk proximate to the second recording layer in a light transmissive way.

The first standard is preferably a CD standard, and the second standard is a DVD standard.

The light of the first standard is preferably a 780nm laser beam, and the light of the second standard is a laser beam between 680nm and 635nm.

The light of the first standard may be between 680nm and 635nm, and the light of the second standard shorter than 600nm.

According to a third aspect of the invention, there is provided an optical disk comprising: a first transparent substrate having a first data pit pattern formed on a surface thereof by recording first standard data; a selective reflection layer adjacent to the first data pit pattern, and having a high reflectance for light of a wavelength based on a first standard and a high absorptance for light of a wavelength based on a second standard different from the first standard; a second transparent layer having a second data pit pattern formed on a surface thereof by recording second standard data; a semitransmission film disposed between the data pit pattern-free surface of the first transparent substrate and the second data pit pattern, and having a high transmittance for light of the first standard and a high reflectance for light of the second standard; and a connection layer for connecting the data pit pattern-free surface of the first transparent substrate to the semitransmission film in a light transmissive way.

Preferably, the selective reflection layer comprises: a reflection film for reflecting the light of the first standard; and an organic pigment layer disposed between the reflection film and the first data pit pattern, and having a high absorptance for the light of the second standard.

The semitransmission film is preferably a dielectric film.

Preferably, the disk further comprises a protection film adjacent to the reflection film.

The total thickness of the semitransmission film and the second transparent substrate is preferably set based on the second standard, and the total thickness of the protection film, the selective reflection layer, the first transparent substrate, the semitransmission film, and the second transparent substrate is set on the first standard.

Preferably, the first standard thickness is 1.2mm, and the second standard thickness is 0.6mm.

The light of the first standard is preferably a 780 laser beam, and the light of the second standard is a laser beam between 680nm and 635nm.

Preferably, the first standard is a CD standard, and the second standard is a DVD standard.

The first standard light may be between 680nm and 635nm, and the second light may be shorter than 600nm.

The main feature of the present invention is that an optical disk has both a first recording layer and a second recording layer and that the disk may be used compatibly in reproducing systems of either first or second standards utilising first or second standard wavelength light beams respectively.

For this purpose, first and second disks are prepared, the total thickness of both disks attached to each other being set in accordance with the first standard, and a thickness of the second disk being set in accordance with the second standard.

The first disk includes a recording layer formed according to the first standard, and a selective reflection layer with a high reflectance for light of a first standard wavelength and a high absorptance for light of a second standard wavelength. On the other hand, the second disk includes a recording layer formed according to the second standard, and a semitransmission film with a high transmittance for the light of the first standard wavelength and a reflectance as provided by the second standard for the light of the second standard wavelength. A selective reflection layer-free surface of the first disk is attached to the semitransmission film-having surface of the second disk by a transparent adhesive, so that a total thickness of both disks is set according to the first standard.

In this disk structure, a first standard optical disk reproducing device can reproduce data recorded according to the first standard by reflecting a first standard laser beam from the data in the selective reflection layer of the first disk. On the contrary, a second standard optical disk reproducing device can reproduce data recorded according to the second standard by reflecting a second standard laser beam from the data in the semitransmission film of the second disk.

Thus, data supporting a plurality of standards are recorded in different recording layers, and produced by corresponding standard optical disk reproducing devices.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic sectional view of an optical disk according to an embodiment of the present invention;

Figure 2 is a graph showing an optical reflection characteristic of a semitransmission film shown in Figure 1;

Figure 3 is a graph showing an optical transmission characteristic of the semitransmission film shown in Figure 1;

Figure 4 is a graph showing an optical absorption characteristic of an organic pigment layer shown in Figure 1;

Figure 5 is a graph showing an optical reflection characteristic of the organic pigment layer and a reflection film shown in Figure 1;

Figure 6 is an exemplary view of light reflection and transmission when reproducing the optical disk shown in Figure 1 in accordance with the CD standard; and

Figure 7 is an exemplary view of light reflection and transmission when reproducing the optical disk shown in Figure 1 in accordance with the DVD standard.

A preferred embodiment of the present invention will be described in detail, and it should be noted that like reference numerals denote the same components throughout, and the detailed description of known functions and structures of the present invention will be avoided if it is deemed to obscure the subject matter of the present invention.

For description of the present invention, CD and dual-DVD standards are exemplarily used as first and second standards, respectively. In this case, a CD standard laser wavelength is 780nm, and a DVD standard laser wavelength is 680-635nm and, in the following discussion will be assumed to be 650nm.

Figure 1 is a schematic sectional view of an optical disk according to an embodiment of the present invention, the representation is not drawn on an accurate

scale. The optical disk of Figure 1 is fabricated by attaching a first disk 10 having a first recording layer 14 for recording CD standard data on a surface thereof to a second disk 12 having a second recording layer 16 for recording DVD standard data on a surface thereof by a connection layer 26 formed of a light transmissive adhesive. A first recording layer-free surface 34 of the first disk 10 is connected to a second layer-having surface 36 of the second disk 12. For convenience' sake, a recording layer-having surface 32 and the other surface 34 of the first disk 10 are referred to as "a protection surface 32" and "the first connection surface 34". The surface 36 and the other surface 38 of the second disk 12 are referred to as "the second connection surface 36" and "a reproduction surface 38", respectively. A laser beam for reproducing data from the first and second recording layers 14 and 16 is incident on the reproduction surface 38. The thickness of the second disk 12 is 0.6mm according to the DVD standard, and the total thickness of the first and second disks 10 and 12 is 1.2mm according to the CD standard.

In the first disk 10, the first recording layer 14 includes a first data pit pattern 40, an organic pigment layer 22, and a reflection film 20 on a protection film 18 of a surface of a first transparent substrate 24. The first data pit pattern 40 is produced by recording the CD standard data. The organic pigment layer 22 and the reflection film 20 under the first data pit pattern 40 act as a selective reflection layer having a high reflectance for a 780nm infrared laser beam and a high absorptance for a near-650nm red laser beam. For example, a reflection film in a conventional CD-R (Compact Disk Recordable), in which a user can write data once, has the same characteristics, and it is widely known that those skilled in the art can easily find such a disk.

As shown in Figure 1, to constitute the selective reflection layer of the organic pigment layer 22 and the reflection film 20, the organic pigment layer 22 is formed of a composition, such as a cyanine-type dye, having a low absorptance for the 780nm laser beam and a high absorptance for the near-650nm laser beam. The reflection film 20 is formed of aluminium or gold, as in a conventional CD. Thus, the optical absorption characteristics of the selective reflection layer is shown in Figure 4 as those of the organic pigment layer 22, and the optical reflection characteristics thereof is shown in Figure 5.

In the second disk 12, the second recording layer 16 includes a second data pit pattern 42 and a semitransmission film 28 on a surface of a second transparent substrate 30. The second data pit pattern 42 is produced by recording DVD standard data. The semitransmission film 28 between the second data pit pattern 42 and the connection layer 26 has a high transmittance for the 780nm laser beam and a reflectance as provided by the DVD standard, for the near-650nm laser beam. It is well-known to those skilled in the art that the above characteristics can be obtained by use of a dielectric film having a reflectance of 18-30% in a general dual DVD as the semitransmission film 28 of the second disk 12. The dielectric is a silicon nitride (SiN), for example. The optical reflection and transmission characteristics of the semitransmission film 38 are shown in Figures 2 and 3, respectively.

The first and second disks 10 and 12 as constituted above are connected to each other by an adhesive, with the first connection surface 34 of the first disk 10 facing the second connecting surface 36 of the second disk 12, and the total thickness of the first and second disks 10 and 12 is set to 1.2mm.

Figure 6 illustrates light transmission and reflection when the thus-obtained optical disk is reproduced by a CD reproducing device using a 780nm laser. Optical paths of incident light and reflected light are distinguished for a better understanding of the present invention, but depend on an optical system of the CD reproducing device in an actual situation. As shown in Figure 6, a 780nm laser light incident on the reproduction surface 38 is sequentially transmitted through the second transparent substrate 30, the semitransmission film 28, the connection layer 26, the first transparent substrate 24, and the organic pigment layer 22, and reflected from the reflection film 20. The reflected light returns through the organic pigment layer 22, the first transparent substrate 24, the connection layer 26, the semitransmission film 28, and the second transparent substrate 30 in reverse order. Thus, the optical disk can be reproduced by the conventional CD reproducing device, in effect as a conventional CD having a reflection film formed on a 1.2-mm thick transparent substrate therein.

On the other hand, Figure 7 illustrates light transmission and reflection when the optical disk is reproduced by a DVD reproducing device using a 650nm laser. Optical paths of incident light and reflected light are distinguished for a better understanding of the present invention, but depend on an optical system of the DVD reproducing device in an actual situation. As shown in Figure 7, a 650nm laser light impinges on the reproduction surface 38, is transmitted through the second transparent substrate 30, and is reflected from the semitransmission film 28 by only 18-30%. The other non-reflected light is transmitted through the connection layer 26 and the first transparent substrate 24, and then absorbed in the organic pigment layer 22. Thus, only 18-30% of the incident light is reflected. Because the 18-30% reflectance corresponds to that of a dual DVD, the optical disk can be reproduced by applying the same optical amplification factor as in reproducing a dual DVD. In addition, the distance between the reproduction surface 38 and the second recording layer 16 is 0.6mm, which also contributes to reproduction of the optical disk by the DVD reproducing device.

In order to reproduce an identical music from a single optical disk according to the embodiment of the present invention by both CD and DVD standard reproducing devices, musical signal, digital data sampled in a sampling frequency of 44.1KHz is recorded as a music

signal, reproducible by the CD standard reproducing device, on a CD surface of the optical disk, and as a high-quality music on the other DVD surface thereof, reproducible by the DVD standard reproducing device.

As described above, since a single optical disk satisfies a plurality of standards, it can be reproduced selectively by different standards-based optical disk reproducing devices.

While the present invention has been described with reference to the specific embodiment, many variations can be made by anyone skilled in the art within the scope of the present invention. Especially though an optical disk satisfying the CD and DVD standards is disclosed in the embodiment of the present invention, it can be extended to a plurality of standards as far as it has the same structure basically. That is, if such conditions as the wavelengths of light used, the thickness of an optical disk, data pit patterns, and the number of layers are varied, a selective reflection layer and a semitransmission film may be formed in compliance with the varied conditions. In this case, materials for the selective reflection layer and the semitransmission film are varied with wavelengths. Thus, the appropriate scope hereof is deemed to be in accordance with the claims as set forth below.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. An optical disk comprising:

   a first recording layer (14) for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a first standard; and

   a second recording layer (16) for recording data reproducible only by an optical disk reproducing device using light of a wavelength based on a second standard different from the first standard.

2. The optical disk as claimed in claim 1, wherein the distance between a reproduction surface (38) of the optical disk and the second recording layer (16) is based on the second standard, and the distance between the reproduction surface (38) and the first recording layer (14) is based on the first standard.

3. An optical disk comprising:

   a first disk (10) having a first transparent substrate (24) and a first recording layer (14) formed on a surface of the first transparent substrate (24), for reflecting light of a wavelength based on a first standard and absorbing light of a wavelength based on a second standard different from the first standard in order to record first standard data therein; and

   a second disk (12) having a second transparent substrate (30) and a second recording layer (16) formed on a surface of the second transparent substrate (30), for transmitting the first standard light and reflecting the second standard light at a reflectance set by the second standard in order to record second standard data therein,

   wherein a first surface (34) of the first disk remote from said first recording layer (14) is connected to a second surface (36) of the second disk proximate to the second recording layer (16) in a light transmissive way.

4. An optical disk comprising:

   a first transparent substrate (24) having a first data pit pattern (40) formed on a surface thereof by recording first standard data;

   a selective reflection layer (20, 22) adjacent to the first data pit pattern (40), and having a high reflectance for light of a wavelength based on a first standard and a high absorptance for light of a wavelength based on a second standard different from the first standard;

   a second transparent layer (30) having a second data pit pattern (42) formed on a surface

thereof by recording second standard data;

a semitransmission film (28) disposed between the data pit pattern-free surface (34) of the first transparent substrate (24) and the second data pit pattern (42), and having a high transmittance for light of the first standard and a high reflectance for light of the second standard; and

a connection layer (26) for connecting the data pit pattern-free surface (34) of the first transparent substrate (24) to the semitransmission film (28) in a light transmissive way.

5. The optical disk as claimed in claim 4, wherein the selective reflection layer (20, 22) comprises:

a reflection film (20) for reflecting the light of the first standard; and

an organic pigment layer (22) disposed between the reflection film (20) and the first data pit pattern (40), and having a high absorptance for the light of the second standard.

6. The optical disk as claimed in claim 4 or 5, wherein the semitransmission film (28) is a dielectric film.

7. The optical disk as claimed in claim 4, 5 or 6, further comprising a protection film (18) adjacent to the reflection film (20).

8. The optical disk as claimed in claim 7, wherein the total thickness of the semitransmission film (28) and the second transparent substrate (30) is set based on the second standard, and the total thickness of the protection film (18), the selective reflection layer (20, 22), the first transparent substrate (24), the semitransmission film (28), and the second transparent substrate (30) is set on the first standard.

9. The optical disk as claimed in claim 8, wherein the first standard thickness is 1.2mm, and the second standard thickness is 0.6mm.

10. The optical disk as claimed in any of the preceding claims, wherein the light of the first standard is a 780 laser beam, and the light of the second standard is a laser beam between 680nm and 635nm.

11. The optical disk as claimed in any of the preceding claims, wherein the first standard is a CD standard, and the second standard is a DVD standard.

12. The optical disk as claimed in any of the preceding claims 1 to 9, wherein the first standard light is between 680nm and 635nm, and the second light is shorter than 600nm.

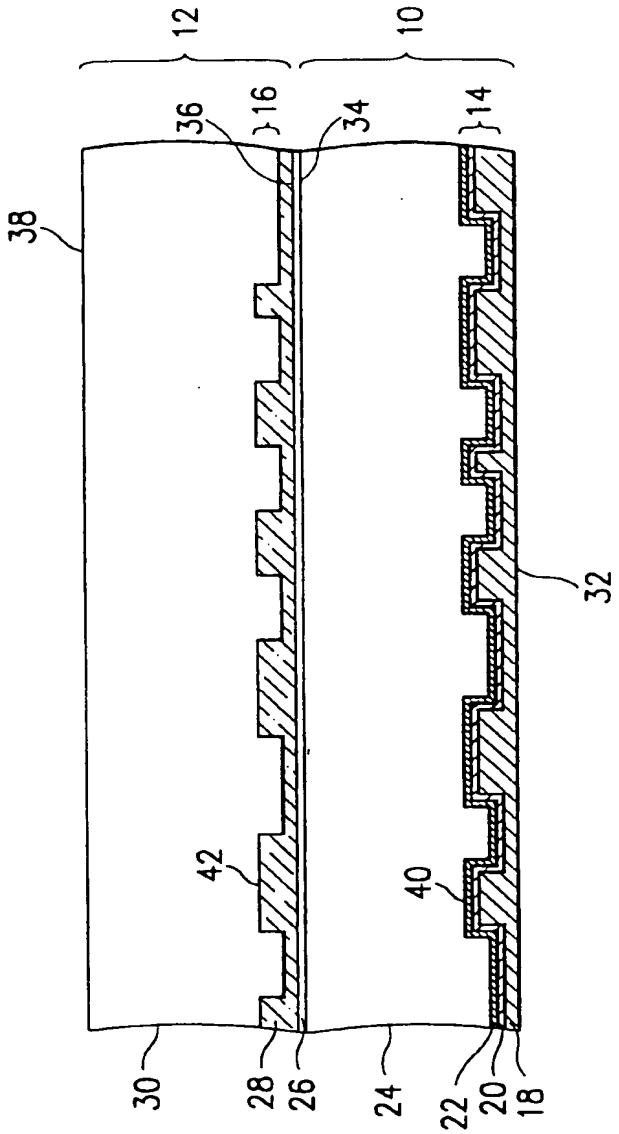

FIG. 1

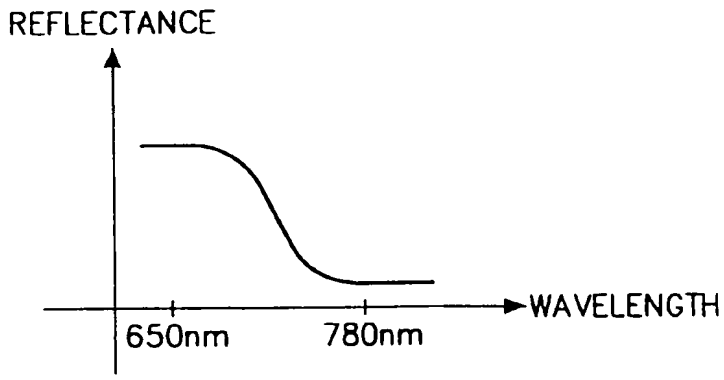
REFLECTANCE
WAVELENGTH
650nm
780nm

FIG. 2

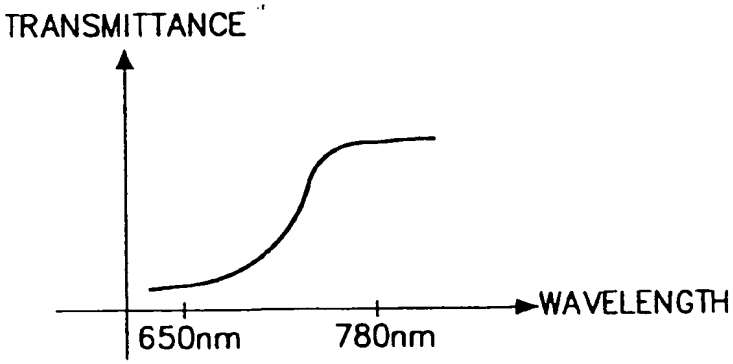
TRANSMITTANCE
WAVELENGTH
650nm
780nm

FIG. 3

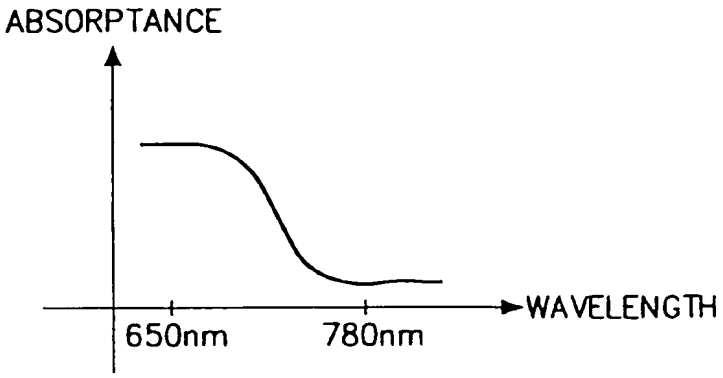
ABSORPTANCE
WAVELENGTH
650nm
780nm

FIG. 4

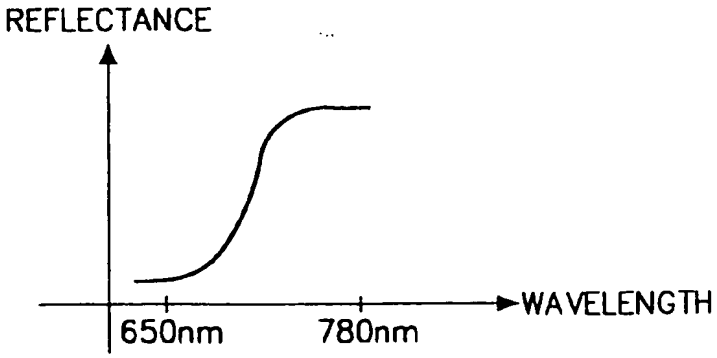
REFLECTANCE
WAVELENGTH
650nm
780nm

FIG. 5

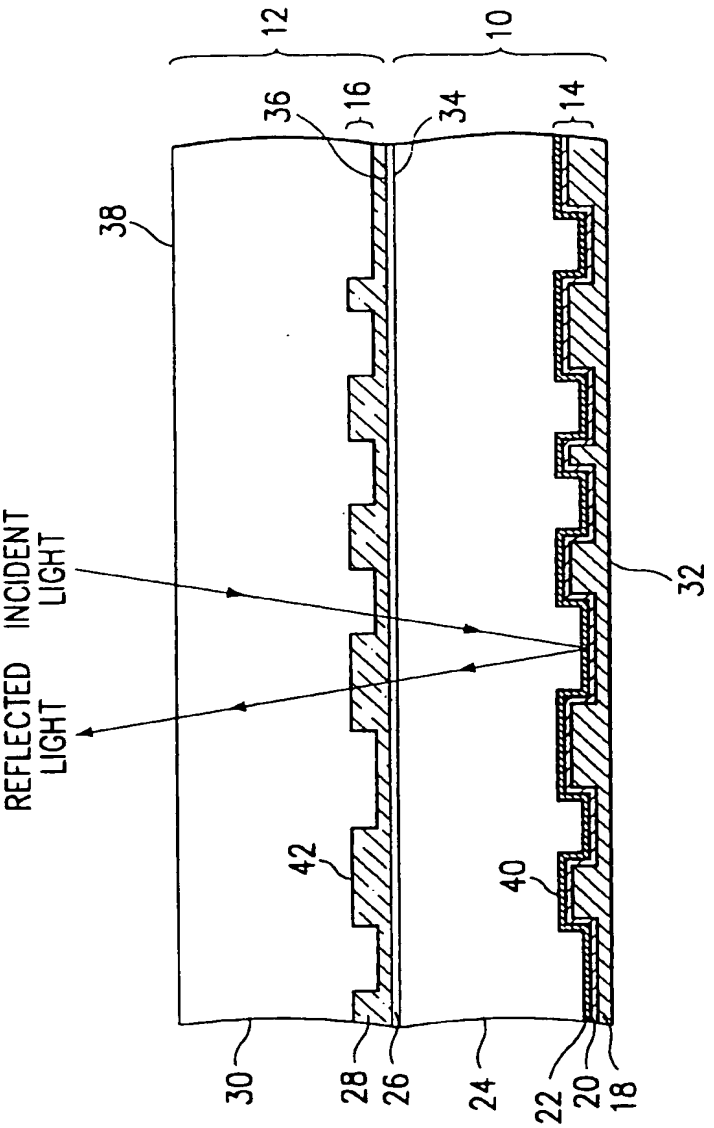
12
10
36
16
34
14
38
INCIDENT LIGHT
REFLECTED LIGHT
32
42
40
30
28
26
24
22
20
18

FIG. 6

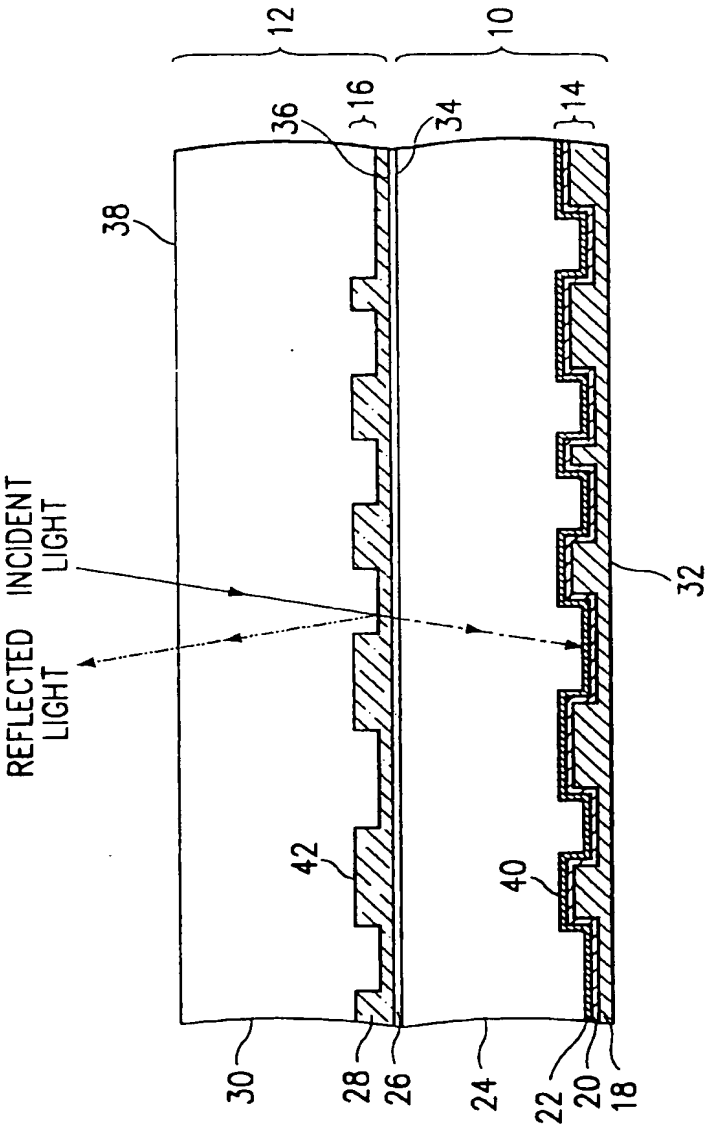
12
10
16
14
36
34
38
INCIDENT LIGHT
REFLECTED LIGHT
32
42
40
30
28
26
24
22
20
18

FIG. 7